September 2013

Creative Thinking

"You can't depend upon your eyes when your imagination is out of focus."

–Mark Twain

Learning Objectives

At the end of this module, you will understand some alternative approaches to creative thinking:

- Problem Posing
- Problem Solving

Creativity

Creativity is not innate nor does it arise from mystical inspiration. It comes from observation of the world around us with a “what-if” attitude.

Creativity:

The ability to create

Create:

- to produce through imaginative skill
- to make or bring into existence something new

(Merriam-Webster Online Dictionary)

Inventions

- What is the most important invention in the past 2000 years?

- Scientific method, civil rights, rudders on boats, western classical music, space travel, laser, transistor, hay, internet, steel, moveable type, antibiotics, atomic bomb, steam engine, the clock, television, idea of free will, unconscious mind, birth control, internal combustion engine, education . . .

Inventions

“The question is impossible to answer with one thing; one could for instance say with some justification “the germ theory of disease” but then that goes back to the microscope -- otherwise no one would ever have seen a germ -- and that to the lens, and eyeglasses may be as important as germs . . . and so on.”

-Philip W. Anderson

“There is no such thing as the single most important invention of the last two thousand years. The evolution of technology doesn't work like that. It's a web of ideas, not a zero-sum game.”

-Howard Rheingold

Some Bad News

- Research indicates that pre-school children are incredible engines of creativity.
- Consider, for example, what a child can do with a blanket, a table, and a cardboard tube – defend a fort or ride a unicorn – whole new worlds where anything is possible.
- Measured levels of creativity then decline throughout elementary and secondary school.
- Perhaps this decline has something to do with the expectation by adults that children adhere to certain structures, rules of conduct, and patterns of thinking.
- By the time people get to university, many are about as creative as rocks.

Creativity

Mature creativity is not innate nor does it arise from mystical inspiration. It comes from observation of the world around us with a “what-if” attitude – a willingness to suspend our dependence upon rules – a view that anything is possible.

- Observing nature
- Focused meditation
- Role playing
- Free writing
- Journal writing
- Problem posing

Observing Nature

Whitcomb Judson, inventor of the zipper in 1893

Did it arise from observing how feathers are held together?

George de Mestrel, inventor of velcro in 1948

Observed how the burrs of certain plants adhere to clothing and animal fur.

Andrew & Steve, inventors of SSTF (Slug Slime Thin Film)

After characterizing the electrical, optical, and mechanical properties of slug slime, they found that only slugs have a use for it.

Focused Meditation

- Put on relaxing music.
- Find a comfortable chair or lie on the floor.
- Close eyes, and breathe slowly and deeply.
- Relax muscles in body, starting with face and moving through the torso down to the legs.
- Visualize ideas in your mind as clouds slowly passing by on a sunny day.
- Switch focus to the particular problem or idea you want to consider.
- Look at it from various perspectives as if it were a cloud floating by.
- Later record any insights or ideas that occur.

Not-so-focused Meditation

- Go for a run
- Put on some loud music
- Take a shower
- Read the newspaper, popular science/mechanics

Role Playing

- Imagination is limited by our experiences.
- Overcome this by seeking out new experiences.

- Example:
  Learn how to best design products for the blind by wearing a blindfold at home for a few hours. Or spend a day in a wheelchair up at SFU to appreciate the difficulties faced by the physically disabled.

- Talk with your intended user group

Free Writing & Brainstorming

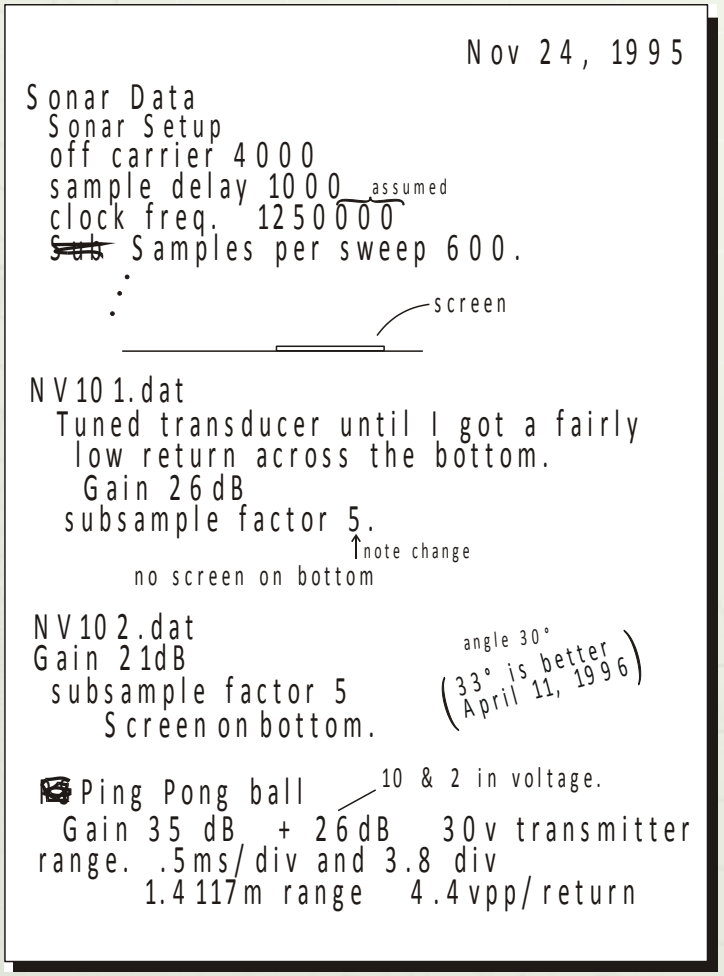
OK So I need to write about brainstorming. Usually its done in a group but not always sometimes individual. Works best in a group though people feed off each others creativity especially if they have different backgrounds - social professional - etc. So how does it work as a group

- *get people together for a time period ½ to 1 hour*
- *anything goes. no criticism - insane crazy ideas are ok*
- *need to ensure nobody gets censored though so need a group leader to facilitate stuff. should also record*
- *Also good to later sort out ideas by being critical and further exploring them*

But the biggest point is to make sure there is no criticism & that people can come up with all sorts of ideas. Should also be fun laughing - sort of like a creative party with stuff written on the blackboard

Informal Journals

Formal Engineering Journals



Nov 24, 1995

Sonar Data
Sonar Setup
off carrier 4000
sample delay 1000 assumed
clock freq. 1250000
~~Sub~~ Samples per sweep 600.

screen

NV101.dat
Tuned transducer until I got a fairly low return across the bottom.
Gain 26dB
subsample factor 5.
↑note change
no screen on bottom

NV102.dat
Gain 21dB
subsample factor 5
Screen on bottom.

angle 30°
(33° is better
April 11, 1996)

~~S~~ Ping Pong ball 10 & 2 in voltage.
Gain 35 dB + 26dB 30v transmitter range. .5ms/div and 3.8 div
1.4117m range 4.4vpp/return

Example of Lab Journal

2001 1025

For Wednesday

spin slides ?
Scribe the bottom 6 spots.

1) Activate Slide with KIO_4 20 mM for ½ hour

to make Potassium Periodate Mela AR.
KIO_4 230 (molecular weight)
for 20mm 0.23g in 50 ml dH_2O
(hot plate shaker).

2) Wash 3 times in dH_2O
3) air dry (fume hood).
4) label & scribe notes. (water proof)
5) stock 10mg/ml

want to spot with 1mg/ml

dilute in PH 8.5 for 1hr
0.15M NaCl
0.1M $NaHCO_3$

9µL PH 8.5 buffer into eppendorf tube.
1µL concentrated amine stock

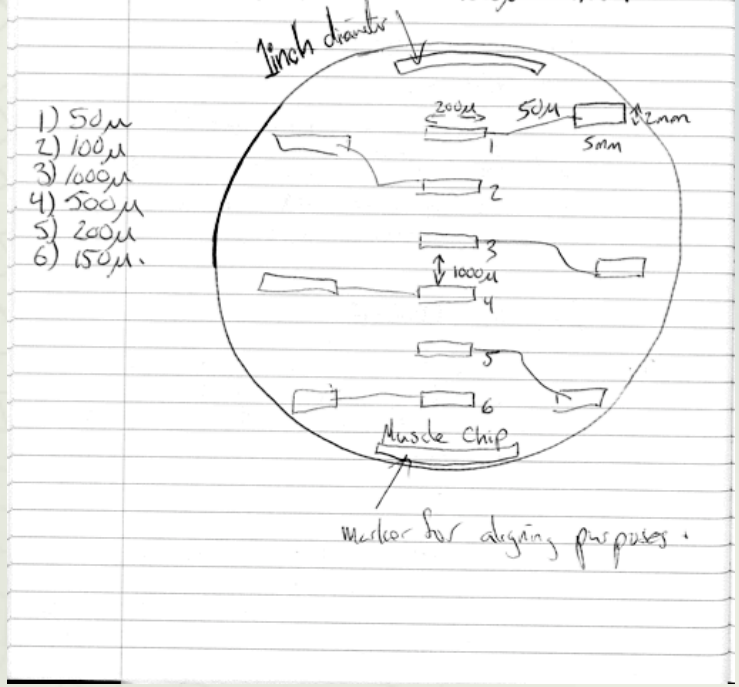
spot to 2µL

2002 01 08

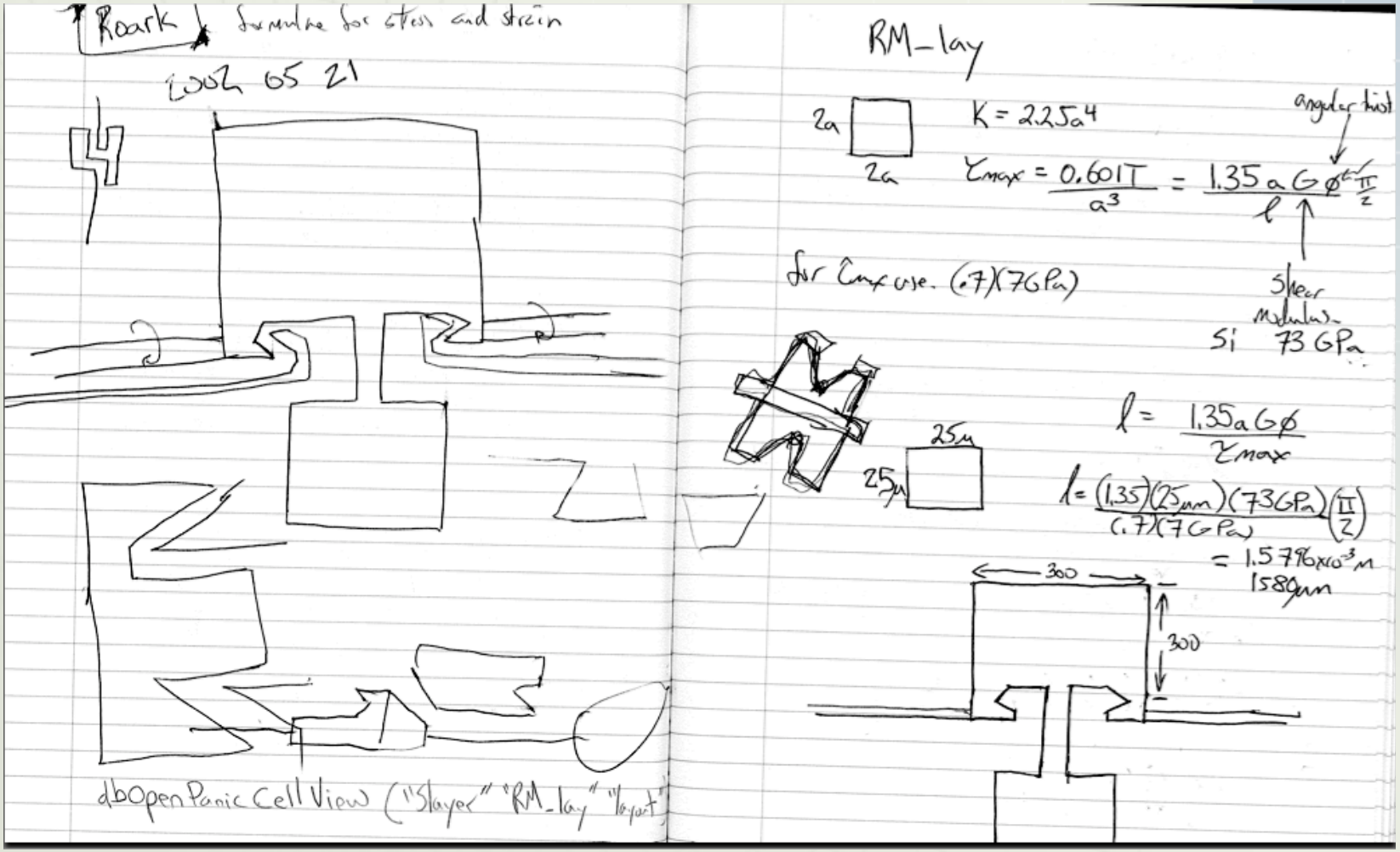
talked to Paul about designing chip for the muscle chip and test of new design for the DNA chip

2002 01 09

1000µm = 1mm



Example of Lab Journal



Problem Posing

Baby Monitor

Heart Monitor

- Things you can improve:
  - Reduce cost, size, complexity
  - Increase reliability, lifetime, user interface

Problem Posing

- Observe how existing industrial, commercial, or consumer products and systems work.
- Note when some device or system irritates you (coin rollers).
- Analyze the purpose of existing products or systems with an eye to finding inefficiencies or problems.
- Analyze the nature of the problem by considering whether solving the problem is *physically* possible.
- Determine how best to improve the product or how to resolve or restate the problem.
- Consider how to develop and market the product (is solving the problem *fiscally* possible?).

Problem-Solving Heuristics

Problem-solving heuristics are structured methods that allow one to discover new information or unexpected solutions to problems:

- Create analogies
- Generate contraries
- Synthesize ideas
- Research the Literature

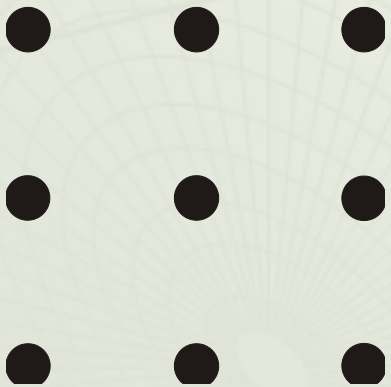
Create Analogies

X **is like** Y – a very powerful technique

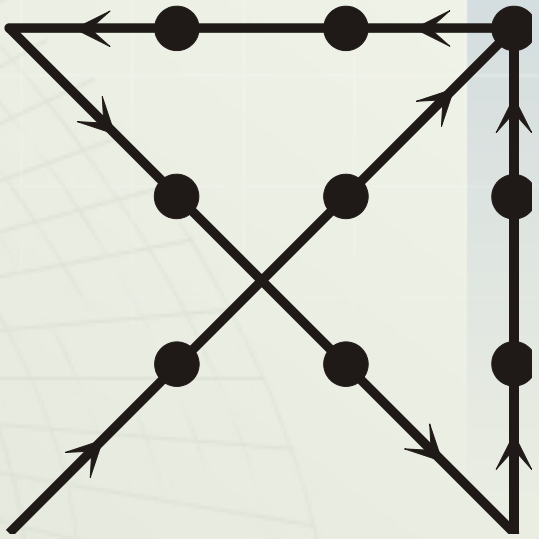
- **Static (or particle) perspective**
  (i.e., How do jet engines work?)
- **Dynamic (or wave) perspective**
  (i.e., Historical changes in jet engine design)
- **Relative (or field) perspective**
  (i.e., How are jet engines like rocket engines – vectored thrust)

Generate Contraries

Thinking Inside the Box
(Thesis)



Thinking Outside the Box
(Antithesis)

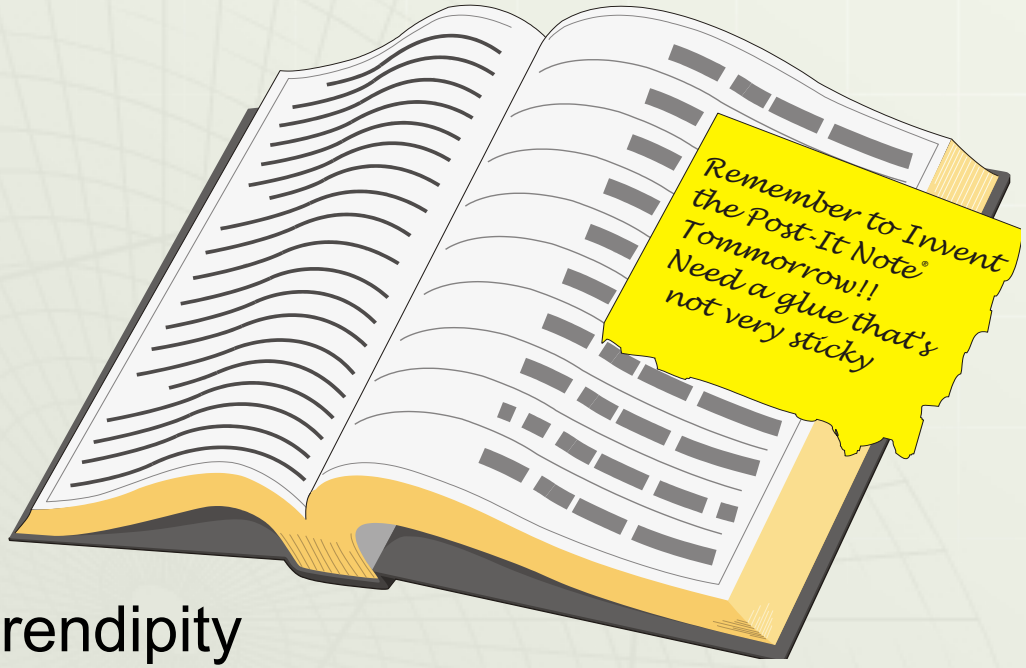


Praise success and punish failure

Praise success **and** praise failure

Synthesize Ideas

The First Post-It-Note (Art Fry)



AKA: Serendipity

"Chance favours the prepared mind."
–Louis Pasteur

Research the Literature

- See what other people have to say about the problem. Friends and colleagues? The web? Popular press? Libraries? Databases?

- www.lib.sfu.ca
- IEEE
- INSPEC
- SPIE
- scholar.google.com

Phrases that Kill Creativity

- We tried that before.
- It costs too much.
- It's too radical a change.
- Let's get back to reality.
- You're right, but . . . .
- Not that again.
- We did all right without it.
- Let's form a committee.
- It can't be done.
- Quit dreaming.
- NO!

Et cetera

Conclusion

“Computer are useless. They can only give you answers.”

–Pablo Picasso

“To invent, you need a good imagination and a pile of junk.”

–Thomas Edison